Rapid Response database for hydrological modeling

Linking remote sensing and process-based hydrological models to increase understanding of wildfire effects on watersheds and improve post-fire remediation efforts

Mary Ellen Miller, PhD
Michael Billmire, CMS-GIS/LIS
Nancy French PhD & David Banach
Michigan Tech Research Institute, Ann Arbor, MI

Forest Service Partners:
Bill Elliot, PE, PhD and Pete Robichaud, PE, PhD
USFS Rocky Mt Research Station, Moscow, ID

Project Summary: Rapidly integrate NASA Earth Observations into process based models in order to aid post-fire mitigation.

Earth Observations applied: Burn severity maps can be derived from multispectral imagery (Landsat, EO-1 ALI, SPOT, ASTER, VIIRS)

Applied Sciences Program

Linking remote sensing and process-based hydrological models to increase understanding of wildfire effects on watersheds and improve post-fire remediation efforts

PI: Mary Ellen Miller, PhD, Michigan Tech Research Institute
(memiller@mtu.edu, (734) 994-7221)

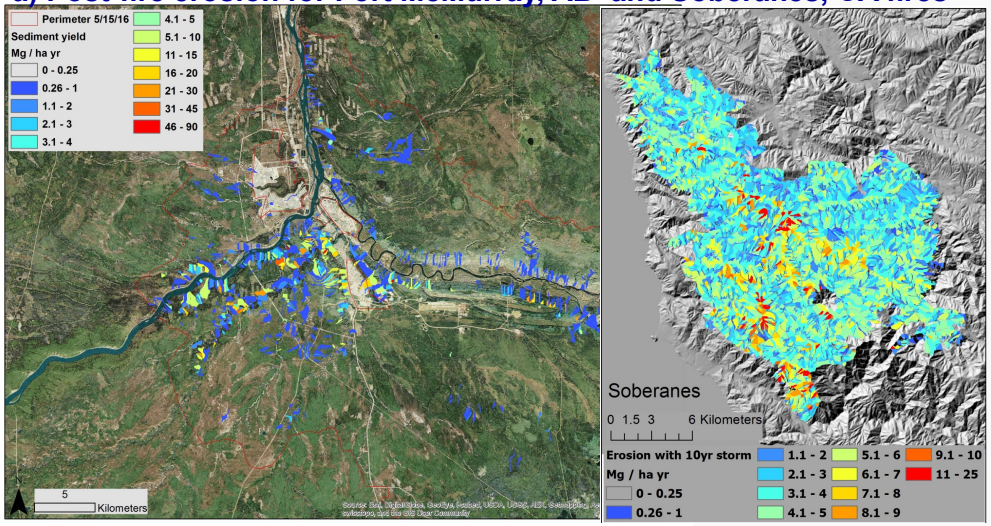
Wildland Fire Program
ACTIVE PROJECT
February 3 2016

Purpose and Objective

Provide tools and datasets that will allow for the integration of NASA Earth Observation data of burn severity into process based models in order to aid decision-making activities related to post-fire risk assessment and rehabilitation. This work is needed as assembling the data needed to run spatially explicit erosion models can be a daunting task even without time constraints, therefore preparing the required input data ahead of time makes sense.

Societal Benefit Area(s): Protect life, property, & natural resources
Geographic Focus: CONUS with emphasis on fire prone states
Targeted End-Users: BAER Teams, hydrologists , watershed managers and researchers

a) Post-fire erosion for Fort McMurray, AB and Soberanes, CA fires



"Your WEPP research was a key input for the "Watershed Clearinghouse," a joint FEMA-State technical services group" Mary M. Shaw FEMA Emergency Management Planner

Approach

Create an online spatial database to support post-fire remediation through erosion modeling. Our database (http://geodjango.mtri.org/geowepp/) for the Western US is online and allows users to import burn severity maps which are combined with soils and land cover to rapidly provide spatial model inputs. By preparing ahead of time the modeling work can be carried out rapidly and the results can be used for decision-making activities related to post-fire risk assessment and rehabilitation. The rapid response website delivers model inputs in mere seconds; previously assembling and formatting this type of data would have taken multiple days.

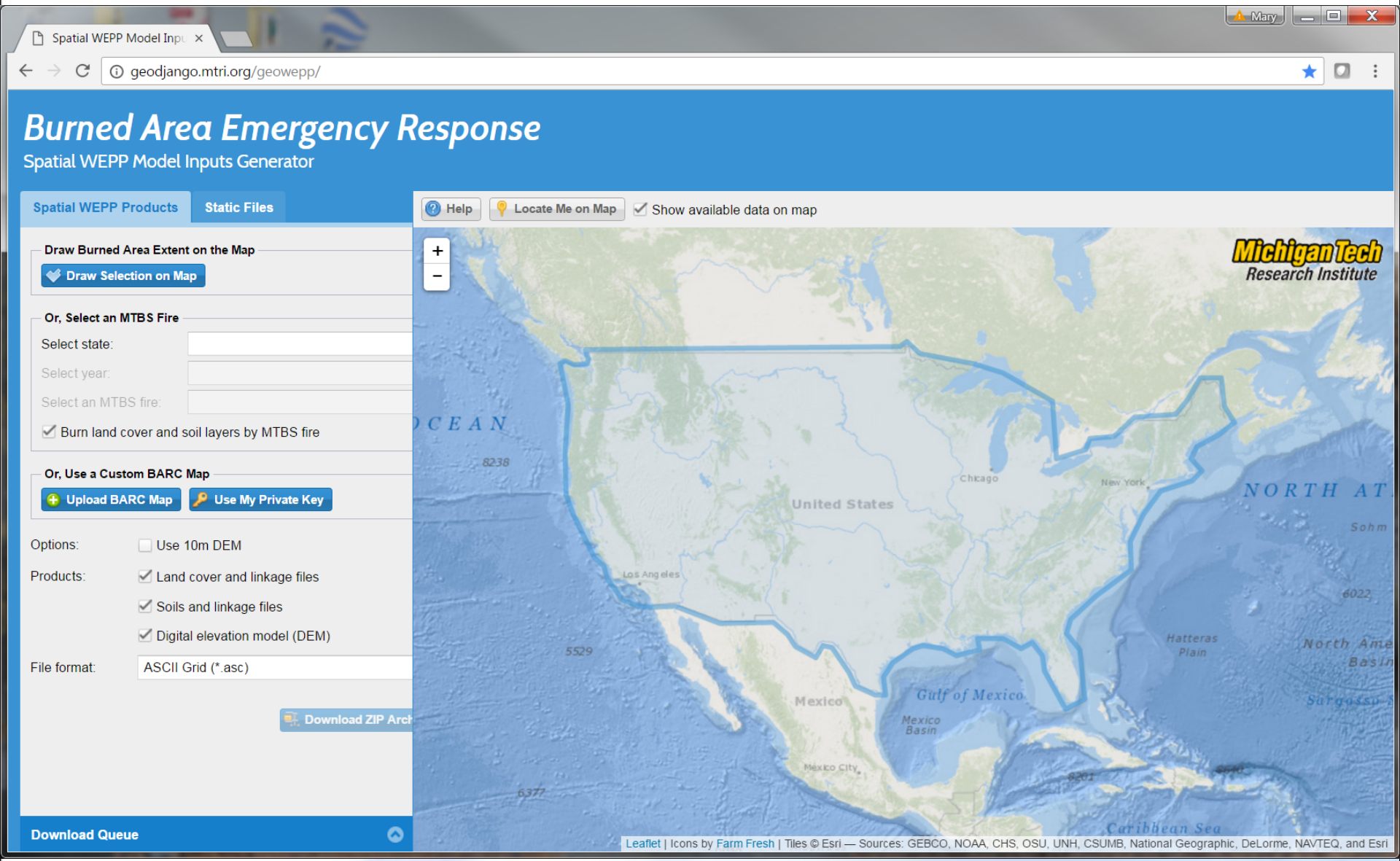
Database already used operationally for multiple fires:
Canyon Creek, OR; Clearwater, ID; Butte, CA; Valley, CA; Soberanes, CA; Happy Camp, CA; Silverado, CA; King, CA

Key Milestones

	Date
Allow users to upload new burn severity maps into database	11/14
Expansion of database to Western US	05/15
Database used by BAER Teams on the Valley & Butte fires, CA; Canyon Creek fire, OR and for fires in Clearwater NF fires, ID	10/15
Expansion of database to CONUS	06/16
NEW open source spatial WEPP interface!!	12/16
Online empirical Debris Flow model & Ravel Rat	06/17
Complete transfer of database to Forest Service online toolset	08/17

$ARL_{Start} = 4$ **$ARL_{Most\ Recent} = 7$** **$ARL_{Goal} = 9$**

Biggest Achievement or Advancement to Date



Biggest Achievement or Advancement to Date

for **Fuels Planning**

- Mokelumne
- Flagstaff
- **Clear Creek Study**

for **BAER Teams**

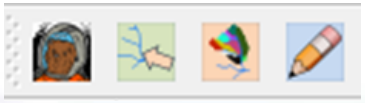
- Canyon Creek, OR
- Clearwater, ID
- Butte, CA
- Valley, CA
- French, CA
- Happy Camp, CA
- Silverado, CA
- King, CA
- Sherpa, CA
- Soberanes, CA
- Fish, CA
- **Cedar, CA**

for **Validation study**

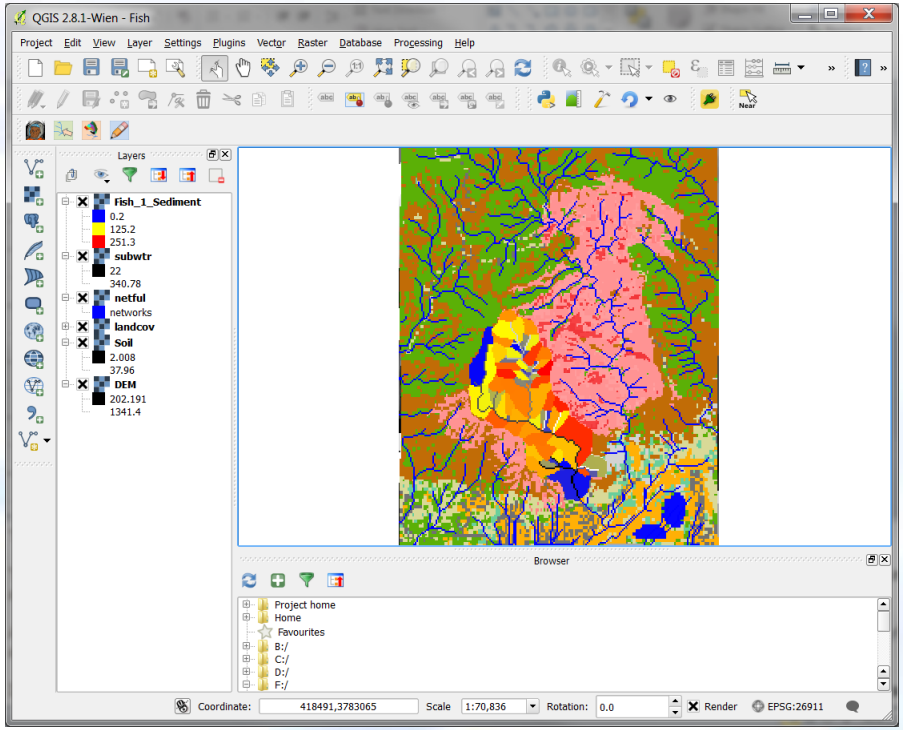
- High Park, CO

Challenge:

Rapid Response Erosion Database (RRED) is Ready now we need modelers!



⇦ Easy to use tool bar



Solution:

Prepare the modelers!

1. Training – Workshop 3/16 follow up with webinar
2. NEW easy to use WEPP interface - QWEPP
3. Manuals & exercises

PI Overall Assessment: Current Status

Summary of Challenges; Problems; Objective Analysis

RRED is ready; our end users need preparation as well!

To overcome this issue:

- New open source interface
- Modeling workshop
- Plan to follow up with a webinar
- Easy to use manual available online

Transfer of RRED may be challenging

Ravel RAT runs slowly

So to Rev up Ravel RAT

- Increased min mass
- Split out KML generator
- Divide & Conquer

Signs of Positive Progress

New easy to use open source interface delivered to Forest Service.

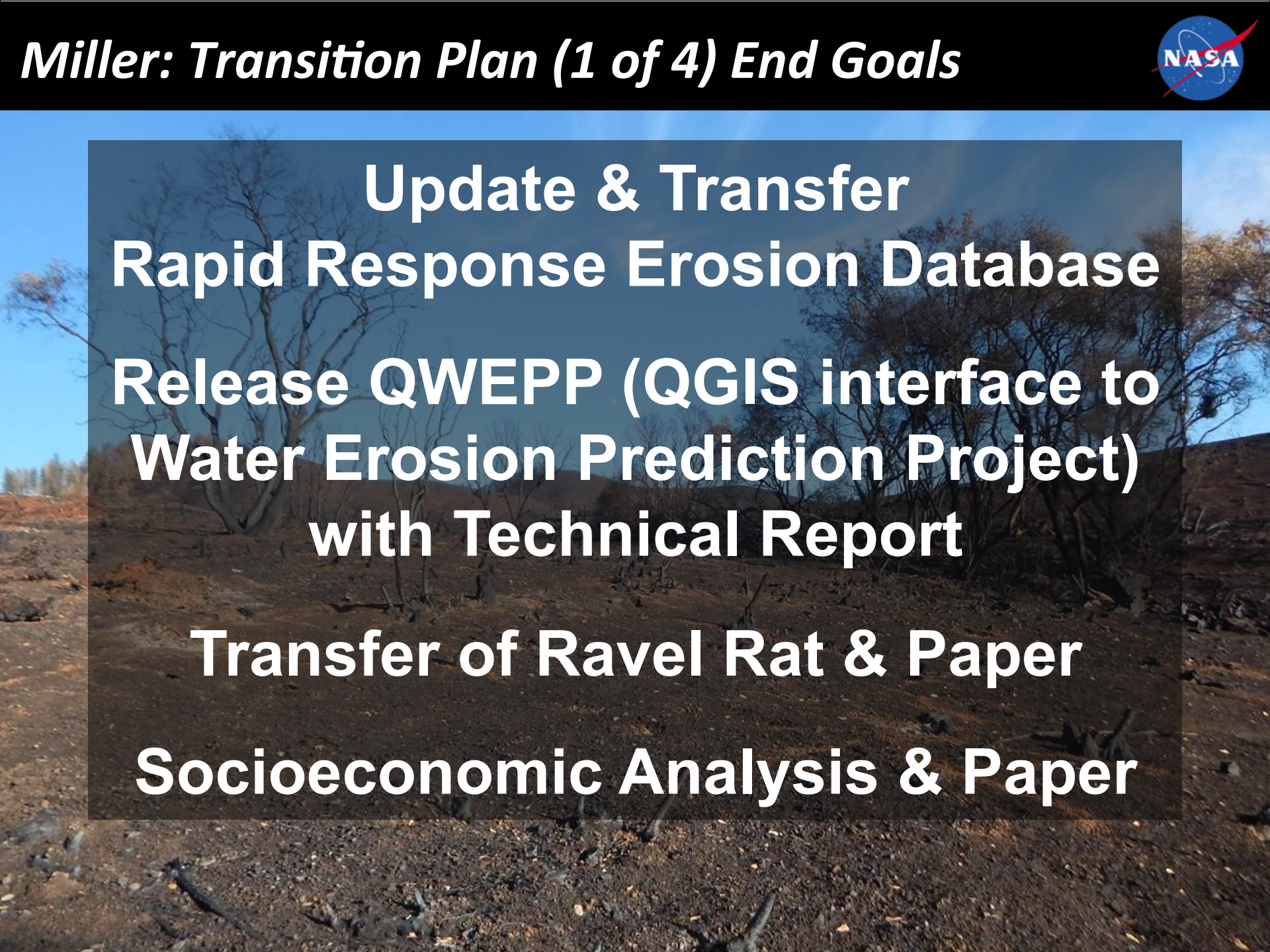
Independent Users! Cedar Fire, Clear Creek fuels study, TMDL

The database has provided support on over a dozen active wild fires and at least four fuels projects.

Forest Service partners are looking into servers

Elements of our program are at ARL: 9 as the products have been used to spatially prioritize ~ 4 million in mulching treatments.

Miller: Transition Plan (1 of 4) End Goals



Update & Transfer Rapid Response Erosion Database

Release QWEPP (QGIS interface to Water Erosion Prediction Project) with Technical Report

Transfer of Ravel Rat & Paper

Socioeconomic Analysis & Paper

Miller Assessment: Transition Plan (2 of 4)

Transfer Plans:

- Communicate with partners
- Open source software
- Instructions for installation

- Help desk services
- Leverage socioeconomic study to promote new resources

Miller Assessment: Transition Plan (3 of 4)

We will need to submit a no-cost extension in order to perform the socio-economic study

We are currently on track to finish our primary objectives and most of our secondary objectives

We currently expect to use all the funds by Spring of 2018

Miller Overall Assessment: Transition (4 of 4)

Highlight (perhaps bullet) steps remaining to achieve your project goals and when do you expect for these to be accomplished.

- Release QWEPP to the public (April 2017) with a technical report \ manual (May 2017)
- Transfer RRED to our operational partners (June 2017)
- Transfer RavelRAT & Debris Flow interfaces to our partners (June 2017) and submit paper for peer review (Aug 2017)

My Forest Service partners would appreciate a server to house the data base with associated backups

– MTRI can continue for a while.

Training support for the tool going forward

I think my biggest challenge is communication - I need to interact more with my partners and end users so that I better understand their needs and challenges!

Budget progress and future plans to spend down the funding by year.

$ARL_{Start} = 4$ $ARL_{Most\ Recent} = 7$ $ARL_{Goal} = 9$

PI Overall Assessment: Impact

Honest Opinion

The combination of our NASA BAER Rapid Response Erosion Database (RRED) and our new open source modeling interface makes it feasible for BAER Teams to use process based models operationally.

The new tools also have the capacity to significantly broaden the use of spatial WEPP models for multiple applications including mining and agricultural.

Project's Impact/Potential as an Analogy

Make a fun analogy to describe the project's overall potential impact

Our baseball analogy:

Our project will be a home run, but it will take a few extra innings!

It will take time for users to discover and utilize our database and new interface.

Relevant Publications, Awards, Accomplishments

Miller M. E., Elliot W. J., Billmire M., Robichaud P. R., Endsley K. A. (2016) Rapid-response tools and datasets for post-fire remediation: linking remote sensing and process-based hydrological models. International Journal of Wildland Fire 25, 1061-1073. http://dx.doi.org/10.1071/WF15162

Elliot W.J., Miller M. E., Enstice N. (2016) Targeting forest management through fire and erosion modelling. International Journal of Wildland Fire 25, 876-887. http://dx.doi.org/10.1071/WF15007

Robichaud, P. R., Elliot, W. J., Lewis, S. A., & Miller, M. E. (2016) Validation of a probabilistic post-fire erosion model. International Journal of Wildland Fire, 25(3), 337-350.

Workshops:

M.E. Miller and Elliot, W.J. 2016. Landscape Analysis of Soil Erosion Risks and Flood Flows following Wildfire. WEPP Workshop, March 22-23, 2016, Davis, CA.

Miller, M. E., Billmire, M., Elliot, W. J. and Robichaud, P. R. 2016. Rapid Response Tools and Datasets: Linking Remote Sensing and Process-based Hydrological Models to support Post-fire Remediation and Fuels Planning. High Park Fire Post-Fire Science Restoration & Research Workshop. Fort Collins, Colorado, November 15, 2016

Best oral presentation!

2015 International Symposium on Remote Sensing of the Environment

Relevant Publications, Awards, Accomplishments

M.E. Miller and Elliot, W.J. 2016. Rapid response tools and datasets for hydrological modeling. Poster and Presentation at AgroEnviron2016 10th International Symposium on Agriculture and the Environment. Purdue University West Lafayette, Indiana, USA May 23-27, 2016

Press releases:

Cooke, Brian; Elliot, Bill; Miller, Mary Ellen; Finney, Mark; Thompson, Matthew. 2016. Protecting the source: Tools to evaluate fuel treatment cost vs. water quality protection. *Science You Can Use Bulletin*, Issue 21. Fort Collins, CO: Rocky Mountain Research Station. 9 p.

Miller, Mary Ellen and Elliot, William. A Rapid Response Database in Support of Post-Fire Hydrological Modeling. Stream Notes Feb. 2016

Environmental Monitor article in Winter 2016 issue: Risks after http://www.fondriest.com/news/environmental-monitor-winter-2016-print-edition-out-now.htm.

Great Lakes Radio News: http://broadcast-everywhere.net/56373/great-lakes-radio-news/press-releases/michigan-tech-researcher-works-to-make-burned-areas-safer/

Informed Infrastructure: https://informedinfrastructure.com/16616/preventing-floods-and-erosion-after-fire/

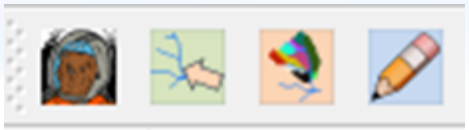
Relevant Publications, Awards, Accomplishments

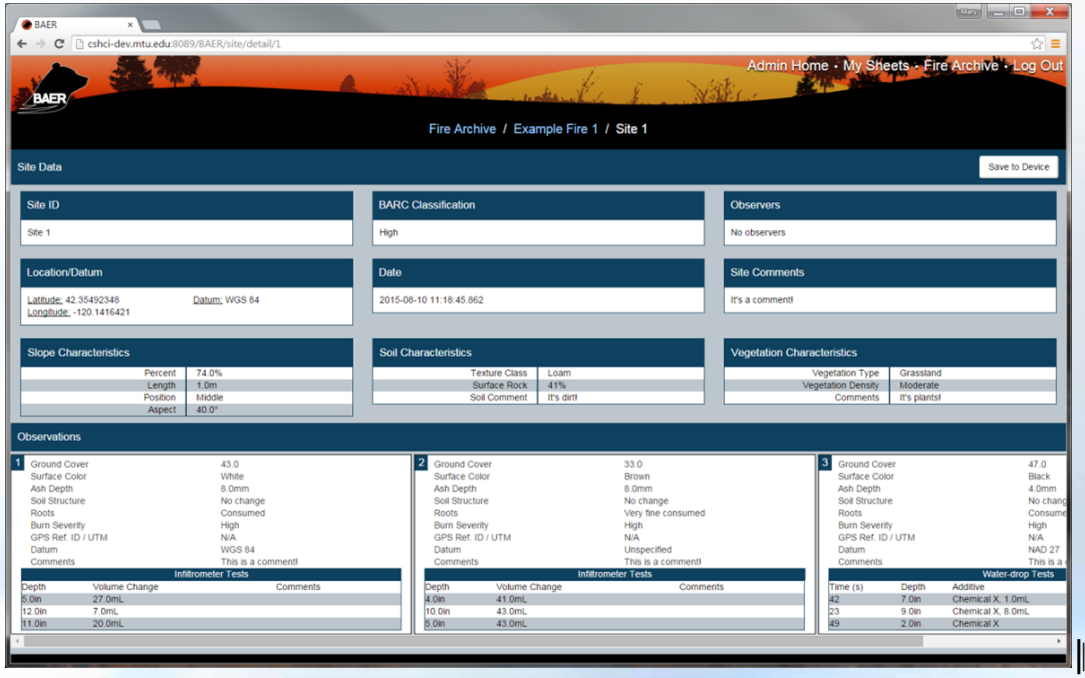
Database being used independently by:

Cedar fire BAER Team
EPA TMDL
Clear Creek fuels project
Students

End users: USDA FS, EPA, FEMA, BLM, CALFIRE, BIA, Academia

Apps for BAER Teams





Concluding Comments

Thank you!

Mary Ellen Miller, PhD
Research Engineer
Michigan Tech Research Institute
3600 Green Court, Suite 100 Ann Arbor, MI
memiller@mtu.edu
(734) 994-7221

http://geodjango.mtri.org/geowepp